# Engineering Underground

## A Description of Lamb Leer Cableway

### By N. V. BALDWIN

THE building of an underground aerial cableway presents many unusual engineering problems. The one now installed in Lamb Leer Cavern was first considered last year in order that visitors to the B.S.A. Summer Meeting might explore this magnificent cave with the least amount of effort.

Reference to the map on Page 71 Vol. 1 No. 2 of "Caves and Caving" will indicate that the entrance and exit passages, to and from the main chamber, terminate at levels 67 and 25 feet respectively from the floor of the chamber. Formerly, the only way of crossing the chamber was by a rope ladder to the bottom, and a corresponding rather shorter ascent on the far side. In 1880 a timber windlass was erected by Mr. James McMurtrie and this was used for a few years to lower visitors down 67 feet to the bottom of the chamber. About the beginning of this century it became unsafe and was recently removed with the exception of the platform.

The problem was to make a safe means of transport across the chamber, and for this purpose a number of alternative schemes were considered. Amongst other methods we considered the possibility of constructing a bridge or ladder, but, it was finally decided that an overhead cableway would best meet the requirements.

Steel construction was decided upon, employing tubular scaffolding for both landing platforms and for the main trestle on the east side. As detailed drawings were considered impracticable, this form of construction was found excellently adaptable.

Anchorages were of paramount importance. On the east side a natural anchorage was found conveniently situated in the form of 25 feet of suspended aragonite floor which had been left in 1880 by miners tunnelling to provide a more easy approach to the entrance of the main chamber. It is of interest to note that such an example of aragonite is seldom found, except in thin seams, whereas the one which proved so useful is no less than twelve inches in thickness. Two 55 feet wire slings were made to encircle the

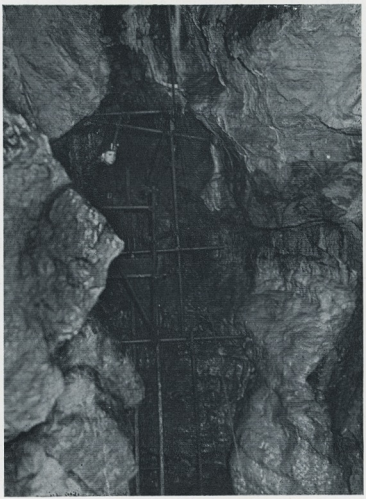

*Photo: E. K. Tratman.*

suspended floor, one for the suspension rope, and the second as an anchor for the trestle.

On the west side we were not so fortunate and a substantial ring anchorage had to be grouted into the side of the passage-way some twelve feet from the entrance. This distance was selected in view of the very shattered condition of the rock on this side of the main chamber.

A survey indicated that our centre line should run along the north side of both entrance and exit passages if we were to clear an obstacle on the west side.

This completed, lists of stores and tools were prepared. The transport of the stores from the surface to the site called for considerable labour and was not without its hazards, especially when it is remembered that all material had to pass through a hole entrance only twenty inches square. Tubes longer than 12 feet would not pass the turn at the bottom of the first 60 foot vertical shaft. A point halfway down this shaft proved the biggest obstacle, where the winding drum, 18 inches in diameter, became wedged and only passed through after the face of the rock had been cut away with a chisel and sledge. To do this in such a confined space, hanging from a rope, proved a long and perspiring process.

Work on the trestle proceeded without incident and the use of vertical and horizontal screws or jacks produced a very rigid structure.

## THE TAKE-OFF PLATFORM

Our attention was next directed to making a suitable take-off platform, and here we decided to make use of what remained of the old timber platform. Examination showed that all horizontal members of Mendip Spruce were sound, even after nearly 60 years, but the vertical members were all in a state of decay. We decided, therefore, to support the horizontal members with steel tubes tied back to the trestle, the timbers themselves being employed to hold the new decking.

The liability for water to collect in the approach passage necessitated a stone drain being built under the platform.

Having completed the trestle and platform on the east side, attention was next directed to the main two and a quarter inch steel wire cable. The two 55 feet slings had been placed in position and each fitted with suitable rigging screws. Where the cable was liable to chafe, it was bound and supported on wooden chocks.

Owing to the restricted space in the first vertical shaft and also the weight of cable, it was at first thought advisable to uncoil on the surface and pull it into position. This was the easiest way, but it would have become extremely dirty so we decided to take it down in one complete coil bound in canvas. The coil was supported on two tubes and although we had some difficulty in preventing kinks it was eventually fed

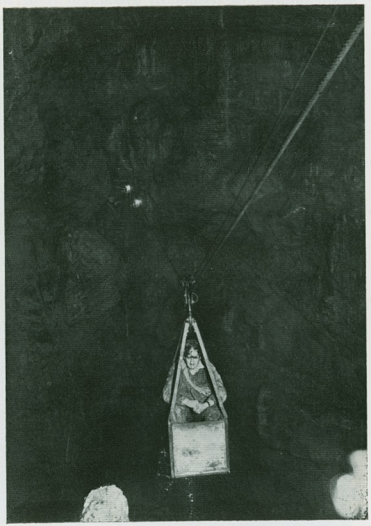

*Photo: E. K. Tratman.*

over the 9" Pitchpine capsill and temporarily anchored in the passage-way on the west side.

With this accomplished, we visualised early completion, but this was not to be. In the first place all our work up to this point could be reached without any climbing other than the first sixty feet shaft, whereas now we had, each time, to enter the great chamber by the 67 feet rope ladder. This meant a life line, etc., and which was worse, delay, particularly when it is remembered that all the work could only be done during evenings and weekends.

## A TEN-HOUR TASK

On the west side our first job was the anchorage. This is the usual ring Lewis bolt, thirteen inches from the neck to the end of shank. Cutting the hole took ten hours' hard work, made uncomfortable by the fact that the passage at this point is only high enough in which to kneel.

We also encountered quite a number of difficulties in building the landing platform on this side. In the first place the rock is badly shattered and loose, making it necessary to exercise caution in fixing tubes with reveal screws. It was here that we lost a very valuable member of our party, Whitehead, who had a miraculous escape from injury.

Immediately in front of the passage (point N on map), is a large piece of suspended rock and to the side of this we intended to strut the landing platform. Whitehead, in climbing to take this strut, grasped a ledge of rock, when the whole piece, approximately two feet square, came away and he fell 20 feet to the bottom of the chamber. The sound of falling rock was terrifying. The working party on this occasion only comprised four in number. The rest of us immediately climbed down as quickly as possible apprehensive of what we should find, and I can say that we were all very relieved when we found him unharmed except for a bruised leg and shoulder. This unfortunately prevented him doing any further work in the cave.

I have already referred to the fact that in order to clear a projection on the side of the cave it was necessary for our centre line to be as far over to the right hand side of the passage as possible, but as the position of the anchorage had to be some twelve feet from the entrance, a good deal of advantage was lost, as we found with the rope in place, that the carriage would foul the projecting rock. To overcome this we diverted the line of the main rope by constructing a horizontal trestle, forming part of and above the landing platform. This we reveal screwed horizontally and strutted to a tubular anchorage, eight feet inside the passage. To this trestle we also attached the return pulley for the winding ropes.

The work in erecting this landing platform proved both uncomfortable and arduous, due to the constant dripping of water and to the fact that the cave face at this point is practically vertical for 25 feet with few ledges to which the platform could be fixed with any degree of security.

It should be mentioned that throughout the whole of our work we had to depend for the most part, upon the light from one small acetylene flare and candles.

With the platform and anchorage on the west side completed, we turned our attention to the winch and operating gear. The winch barrel with integral eighteen inch diameter brake drum, was positioned between the four legs of the trestle and was supported by two standard swivel couplings. Two-inch outside diameter brass bushes were secured and turned to suit the diameter of the winch shaft. This proved extremely satisfactory and easy to assemble as we were able to use standard couplings which were also self-aligning.

It will be seen that we were creating an ordinary main and tail haulage except that, usually with a haulage of this type, two separate winding drums are employed,

whereas in our case both ropes would be wound and unwound simultaneously on the same barrel. To keep the two ropes separated, a one inch thick hard wood split flange, clamped by a steel band, was placed in the centre of the drum. Theoretically, we calculated that when one section of the drum was full we should be winding rope in faster than it was paid out, equivalent to eight feet of rope. We figured, however, that there would be sufficient slack in the hauling ropes to compensate for this and our assumption proved correct.

As the carriage on the east side had to land its passenger within a few feet of the trestle, the angle of the main rope with the loaded carriage in this position was quite steep. We had allowed a normal dip in the main rope of eight feet and we did not wish to reduce this owing to the increased stresses involved. The load on the hauling rope with the carriage at this point was calculated at approximately 300 pounds, so that it was obvious that a holding brake was necessary. Again we utilised a standard swivel coupling, and made an effective footbrake by clamping a wood block to a length of two-inch tube. To this tube we fixed a wire sling to a hinged pedal on the platform. Two winding handles were employed, one on each side of the trestle.

## THE CARRIAGE.

Finally we came to the design of the carriage. We could have employed an ordinary "Boson's chair" but to get in and out of this would have presented some difficulty and danger. It was therefore decided that the carriage must be of some rigid construction in which the passenger could sit quite safely without being strapped in. A rectangular timber carriage with a sliding seat was made, carried at each corner by angle-iron brought to a centre point to which was fitted a pin for attaching to the hook of the bogey. The carriage had to be made in sections and assembled on site.

This was our final piece of work and on July 22nd the cableway was officially opened in the presence of Mr. Barnes and others, by our old friend Mr. Balch, suspended in mid-air from the centre of the great chamber.

The whole of the work, necessitating 28 visits, was carried out by fourteen members of the Wessex Cave Club, extending over a period from May 17th to July 19th, with a total working time of approximately 60 hours. We utilised 370 feet of two-inch steel scaffolding, 14 revealed screws, 260 feet of one-inch and 300 feet of two-and-a-quarter inch steel wire rope, etc., at a total cost of £64 0s 0d.

In conclusion, I should like to pay tribute to Messrs. A. Marshall Hunt and Co., Bristol, for their valuable assistance in making the special metalwork required, and particularly to Messrs. W. Weaver, J. W. Duck, A. Wadsworth, E. W. Sharpe and A. E. Whitehead for their loyal and conscientious support.

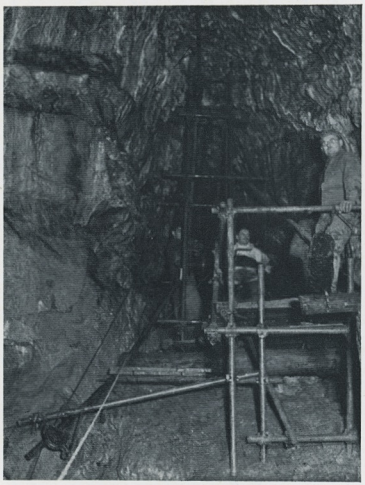

*Photo: E. K. Tratman.*